World Heritage Biodiversity:
Filling Critical Gaps and Promoting Multi-Site Approaches to New Nominations of Tropical Coastal, Marine and Small Island Ecosystems

Potential Tropical Coastal, Marine and Small Island World Heritage Sites in ***Southeast Asia***

L.M. Chou
Dept. of Biological Sciences
National University of Singapore
Blk. S2, 14 Science Drive 4
Singapore 117543.

INTRODUCTION

Within the context of this paper, Southeast Asia is regarded as the region comprising the countries of Philippines, Indonesia, Brunei Darussalam, Malaysia, Singapore, Myanmar, Thailand, Cambodia and Vietnam (Fig. 1). All these countries (including Laos, which does not have a coastline) belong to the political grouping of the Association of Southeast Asian Nations (ASEAN).

Southeast Asia is recognized as having the world's richest marine biodiversity (considered at genetic, species and ecosystem levels) (IUCN/UNEP, 1985; Kelleher *et al.*, 1995). It contains over 25% of the world's two major tropical coastal and marine systems, coral reefs and mangroves. The region is highly archipelagic (about 25,000 islands of varying sizes) and marked by extensive coastlines. Resources of the region's marine environment are heavily relied on for economic development. Destructive fishing is widespread and remains a strong threat to coral reefs. Resource utilization intensity however is not uniform across the region because of uneven distribution of its human population and areas of good marine biodiversity still exist. The region continues to hold a rich array of marine life, and its abundance of coral reefs, mangroves and seagrass beds support about the most diverse marine flora and fauna in the world,

Various forms of marine environmental protection are in place including marine protected areas, marine pollution management programs and integrated coastal management initiatives. These activities have to be intensified if the region's rich marine biodiversity is to be maintained. Ongoing investigations continue to reveal new species and further enhance our understanding of the region's marine biodiversity. The most recent and exciting discovery has to be that of the coelacanth from Manado (Erdmann & Moosa, 1999), which emphasizes the necessity and urgency to protect marine biodiversity before they are forever lost to science and society. Only 4 marine areas in the region (Fig. 1) are listed as World Heritage Sites (Indonesia's Ujung Kulon National Park and Komodo National Park, Philippines' Tubbataha Reef National Marine Park, and Vietnam's Ha Long Bay). Many more marine areas have the criteria for listing as World

Heritage sites and their consideration will correct the conspicuous under-representation in the region.

BIOPHYSICAL SETTING

Southeast Asia's marine environment, stretching between longitudes 93^0E and 141^0E, and latitudes 21^0N and 12^0S, covers an estimated 9 million km^2 equivalent to 2.5% of earth's ocean surface. Yet, it supports a great variety of coastal and marine ecosystems, noted for their rich species diversity. The regions' countries have a combined coastline of 92,451 km, which is 15.8% of the world's total. The archipelagoes of Indonesia (over 17000 islands) and the Philippines (over 7000 islands), the two largest in the world contribute 59% and 24% respectively to Southeast Asia's coastline length. Numerous islands of varying sizes, mostly volcanic or coral, compartmentalize but do not isolate the water body into seas again of different sizes with varying degrees of embayment. The island-dotted region forms a link between the Pacific and the Indian oceans, and separates the continental landmasses of Asia and Australia.

Extensive coastlines influenced by localized geomorphological conditions through time provided the region with a variety of coastal and marine ecosystems that is recognized as the greatest throughout the entire Indo-Pacific (IUCN/UNEP, 1985a & 1985b). Almost all types of coastal features are present such as cliffs, coves, beaches (sandy, rocky, muddy), deltas, spits, dunes, lagoons, estuaries. The seas straddle the extensive Sunda (Asian) and Sahul (Australasian) continental shelves as well as deep sea basins, oceanic troughs and trenches, and steep continental slopes. Surface current patterns point to the Pacific as a main source of water mass. Warm equatorial currents sweeping west across the Pacific deflect north at the Philippines towards Taiwan and Japan as the Kurioshio current, or south into the Celebes Sea as the Mindanao current, forcing its way between the islands of eastern and central Indonesia into the Indian ocean.

The region is heavily influenced by monsoons, which define wet and dry seasons. Heavy precipitation during the wet season transports silt and nutrients from land and sea, mostly through the many major river systems. The monsoons also reverse surface current patterns periodically, resulting in dynamic circulation processes. The tropical waters experience little change in surface temperature and moderate tidal variation influenced by both oceans. Diurnal tides prevail in the South China and Java seas while mixed tides occur in many of the other seas. Average annual range of sea surface temperature is less than 2^0C nearer the equator and 3 to 4^0 away from it. Stratification of the water column occurs in some of the deeper seas but over most of the continental shelves, the temperature remains uniform throughout the water column. Salinity is variable because of high rainfall and runoff from large rivers. It is generally lower ($28^0/_{00}$) in sheltered inshore areas compared to the open seas ($34^0/_{00}$).

Coral reefs are common throughout the region while sheltered coasts promote development of mangrove and seagrass systems. Large river deltas such as the Mekong and Chao Phraya form an important ecological component. Tropical conditions with high

rainfall and constant warm temperature favor the high productivity of these ecosystems. Singh *et al.* (1994) compared mangrove ecosystem productivity based on different parameters such as phytoplankton production, primary production, benthic primary productivity and total litter production, and showed that the region's mangrove forests maintained the highest values worldwide.

COASTAL AND MARINE BIODIVERSITY

Coastal and marine ecosystems of the region support species richness at levels greater than elsewhere. Sixteen seagrass species are present in the region (Fortes, 1995), all of which are also represented in the Philippines alone, making it the country with the second highest species of seagrass in the world after Australia. Apart from the high species richness, the seagrass ecosystem also supports a high diversity of associated fauna and flora (Sudara *et al*., 1991; Kiswara, 1994; Fortes, 1995). In addition it serves as a critical habitat to the dugong and four species of turtles, all of which are endangered.

Japar (1994) reported 50 exclusive and 171 non-exclusive mangrove plant species in the ASEAN countries. A review of mangrove-associated animal communities (Low *et al.*, 1994) contained a species list comprising 545 fish, 2 amphibians, 24 reptiles and 60 mammals. The authors concluded that the number of fish species was much more than previously known or expected. In addition, they provided a list of endangered vertebrate species (excluding fish) present in the region's mangrove forests, consisting of 9 birds, 1 amphibian, 1 reptile and 6 mammals. Included are the crab-eating frog (*Rana cancrivora*) and the proboscis monkey (*Nasalis larvatus*).

The region is the global center of hard coral diversity (Veron, 1995), particularly around eastern Indonesia, Philippines and the South China Sea's Spratly islands, where over 70 hard coral genera are present. Throughout the rest of Southeast Asia, over 50 hard coral genera can be found. The central Indo-Pacific region, of which Southeast Asia is a part, is also considered to be the center of evolution of hermatypic corals. New species of scleractinian corals continue to be discovered from the region as investigations expand (e.g. Wallace, 1994). The reef ecosystem supports a high diversity of associated plant and animal species, contributing further to the region's status as the global center of diversity for marine invertebrates such as molluscs and crustaceans (Briggs, 1974).

Over 2000 nearshore fish species have been recorded in the Philippines (Briggs, 1974). The wider East Asian region is considered as the center of the world's radiation of true sea snakes (Family Hydrophiidae). Of the 14 genera and 47 species worldwide, all 14 genera and 30 species are represented in East Asia. More than 30 cetacean species are present in the region (UNEP, 1996). Relatively less known are the soft-bottom macrobenthic communities. These are also diverse with at least 368 families identified under the ASEAN-Australia Living Coastal Resources Project from 1985 to 1994 (Chou *et al.*, 1994). These communities contribute to the ecological processes of the marine environment and perform a significant role in maintaining ecological productivity.

In spite of oceanic interconnectivity, the region retains many endemic species. For example, the gastropods, *Tectarius rugosus*, *Littoraria vespacea*, and *Littoraria conica* are known only from the region (Rosewater, 1972). Abbot (1960) found the highest number of *Strombus* species in the Philippines, Okinawa and Indonesia, and a decline in species diversity east and west of then region. The pattern of declining species diversity away from Southeast Asia is common to many groups of invertebrates, fish and sea snakes. Allen (1985) showed that pomacentrid species diminished with increasing distance into the Pacific from Southeast Asia. Species decline of inshore fishes from the region eastwards across the Pacific Ocean (Myers, 1991) suggests that the region provides the source of larval recruits to the seas east and west of it. Sea snake distribution showed a similar species decline west of Southeast Asia and east past the Australasian region (Voris, 1972).

Within the region itself, there is evidence of genetic isolation influenced by localized and major currents and bottom topography. This is demonstrated by the genetic study of stomatopod populations in Indonesian seas (Barber *et al.*, 2000). Endangered marine species such as dugongs and turtles are widely distributed but under high threat as their critical habitats are steadily lost to development and human population pressures.

STATUS OF MARINE PROTECTED AREAS

A review by Kelleher *et al.* (1995) indicated the existence of 233 marine protected areas (MPAs), large and small throughout the region. Of those for which data are available, about 13% had a “high” management level, 31% a “moderate” management level, and the remaining 56% a “low” management level (“high” indicating that the MPA generally met management objectives, “moderate” where management objective is partially met, and “low” where management objective is not met).

The region has two RAMSAR sites that include coastal elements: Berbak protected area in Indonesia (inter-tidal terrain), and the Red River Estuary in Vietnam (estuarine terrain). In addition, several Biosphere Reserves include coastal elements (Indonesia: Komodo National Park, Tanjung Puting National Park, Gunung Leuser Nature Reserve, Siberut Nature Reserve; Philippines: Palawan and Puerto Galera Biosphere Reserve). Four of the region’s MPAs are inscribed as World Heritage Sites. These are Indonesia’s Ujung Kulon National Park and Komodo National Park, Philippine’s Tubbataha Reef National Marine Park, and Vietnam’s Ha Long Bay. At the regional level, ASEAN Heritage Sites include Thailand’s Tarutao National Park and Philippines’ Tubbataha Reef National Park. The latter collaborates with the Malaysian state of Sabah to provide more effective protection of marine turtles that constantly cross their territorial seas.

Clearly, the current four World Heritage Sites with a marine component are insufficient in this region, which contains the world’s greatest marine biodiversity and over 25% of the world’s coral and mangroves. In the report by Kelleher *et al*. (1995), 22 areas were considered to be of national priority, of which, 10 were accorded regional priority status (Table 1). These were selected by members of the IUCN-CNPPA (Commission on

National Parks and Protected Areas) Working Group for the East Asian Seas, based on criteria, which emphasized ecological and biogeographic significance, political support and feasibility of management success.

In addition, the IUCN-CNPPA Working Group drew attention to the Spratly islands in the South China Sea, highlighting the regional and probably global, significance for marine biodiversity conservation. Six countries have conflicting territorial claims over these islands, presenting a major obstacle to any environmental or resource protection measures. The Spratlys consist of some 600 coral reefs located within the highest biodiversity area of the wider East Asian Seas and are likely to be an important source of larvae and juveniles for fish and invertebrates. McManus (1992) suggested that a treaty modeled along the Antarctic Treaty System or the Torres Strait Treaty (between Papua New Guinea and Australia) could be applicable. Both treaties provided for conservation of areas that were subject to jurisdictional dispute.

TABLE 1. Southeast Asian marine areas considered of national and regional priority by the IUCN-CNPPA Working Group for the East Asian Seas.

Country	Location	National priority	Regional priority
Indonesia	Laut Banda Marine National Park	x	x
	Taka Bone Rate Marine National Park	x	
	Karimun Jawa Marine National Park	x	x
	Teluk Cendrawasih Marine National Park	x	x
Malaysia	Pulau Perhentian Besar Marine Park	x	x
	Pulau Redang Marine Park	x	x
	Semporna Islands	x	x
	Matang Forest Reserve	x	
	Tengku Abdul Rahman Park	x	
	Pulau Sipadan Marine Reserve	x	
Philippines	Tubbataha Reefs National Marine Park	x	x
	Taklong Island National Marine Reserve	x	
	El Nido Marine Reserve	x	
Singapore	Southern islands	x	
	Sungel Buloh Nature Park	x	
Thailand	Mu Ko Similan National Park	x	x
	Mu Ko Surin National Park	x	x
	Hat Chao Mai National Park	x	
	Mu Ko Chang Islands National Park	x	
Vietnam	Con Dao Islands National Park	x	x
	Nam Du Islands	x	

Cat Ba Islands	x

WORLD HERITAGE SITES AND CRITICAL MANAGEMENT ISSUES

The completed questionnaires returned by managers of the region's four World Heritage Sites (marine) showed benefits from their WHS status ranging from high to low. No one indicated that there was no benefit. All respondents unanimously agreed that the sites benefited from increased international attention, which was greater than regional and national attention. Collaboration with national authorities was higher than with provincial and local authorities in Indonesia and Vietnam. For Tubbataha, collaboration with national, provincial and local authorities was low. Collaboration with non-governmental organizations and other protected areas was at a higher level, particularly in Komodo, where The Nature Conservancy was fully involved in the development of a long-term management plan (Pet & Yeager, 2000). Collaboration with local communities was low except in Komodo. Private sector (mainly tourism) collaboration was low in Tubbataha and Ha Long, but medium at both Indonesian sites. All four sites have management plans in place and monitoring programs, but enforcement is hampered by constraints of management resources (labor, equipment and finance).

Marine resource management status improved in Komodo and Ujung Kulon, showed no apparent change in Ha Long Bay, and both, declined and improved (spatially differentiated) in Tubbataha. Common management issues are illegal and over-fishing and decline in coral reef health. Sites with mangrove ecosystems suffer from mangrove vegetation extraction. Unmarked site boundaries, inadequate legal protection, and lack of management staff were constraints faced by all four heritage sites. Ecotourism is an opportunity identified by all four respondents. In addition, education, research and species protection were highlighted for Komodo and Ujung Kulon.

All four heritage sites will benefit from increased overall biodiversity value by expanding their present management boundary. The inclusion of adjacent Bastera and Beazzley reefs within Tubbataha's management site is proposed. Komodo has several adjacent reefs of high biodiversity significance, which are currently beyond its management boundary. Respondents for Ujong Kulon and Ha Long Bay also felt that management boundary expansion will increase overall biodiversity value but pointed out the need for further research.

The potential for incorporating existing sites as part of a cluster with other provincial or national sites was present for Komodo, Ujung Kulon and Tubbataha. At Ujung Kulon, pelicans migrate between it and Panaitan Island, which is protected, while green turtles migrate to other parts of Ujung Kulon peninsula that have protection status. These other protected areas form a natural cluster with Ujung Kulon heritage site. At the same time, it could form a natural cluster with Krakatau Strict Nature Reserve, which is an important site for research into reef recovery from volcanic activity.

Komodo National Park attracts spawning aggregations of large fish species such as manta rays and groupers. It is also an important site along the corridor of migratory species such as turtles and whales and would form a natural cluster with Indonesia's other marine national parks to its northeast, Taka Bone Rate and Wakatobi.

Tubbataha Reef National Park lies in the same province with Philippine's second natural Heritage site, the Puerto Princesa Subterranean River National Park (a limestone cavern topped by tropical karst vegetation). Both, representing different ecosystems, complement each other and offer a rich and varied biodiversity. Tubbataha reefs is ecologically and geologically similar to the Spratly island grouping and can be considered for nomination as a trans-border site.

POTENTIAL WORLD HERITAGE SITES

Ten potential sites with a marine component are proposed for listing as World Heritage Sites (Table 2). Most of these were identified as having regional priority by the IUCN-CNPPA Working Group for East Asian Seas at regional meetings, which resulted in recommendations contained in the report by Kelleher *et al.* (1995). Table 2 provides an assessment of these sites based on: 1) biodiversity and other outstanding values, 2) existing management, 3) protection status, and 4) regional capacities to support their nomination.

Some of the proposed sites would form natural clusters among themselves or with existing World Heritage sites. The Spratly Islands qualify immediately as a trans-boundary site. The Turtle Islands Heritage Protected Area, currently managed by Malaysia and Philippines represents the world's first trans-boundary marine park for greater efficiency in protecting marine turtles. Thailand's Surin and Semilan islands make up a cluster and has the potential of expanding as a trans-boundary cluster with some parts of Myanmar's Mergui islands. None of the latter is proposed for lack of published information, but anecdotal reports from recreational divers suggest high biodiversity in these islands.

In a region with the world's richest marine biodiversity, it will not be surprising for many other sites to be proposed for World Heritage Listing. Research exposes remote areas with intense biodiversity richness. Imminent is the threat to coastal and marine living resources, and management has to be increased and improved to slow down or halt the trend.

REFERENCES

Abbot, R.T. 1960. The genus *Strombus* in the Indo-Pacific. Indo-Pacific Mollusca, 1(2): 33-146.

Allen, G.R. 1985. Butterfly and angelfishes of the world. Vol. 2. Mergus Publishers, Melle. 217p.

Barber,P.H., Palumbi, S.R., Erdmann, M.V. & Moosa, M.K. 2000. A marine Wallace's line? Nature, 406: 682-683.

Briggs, J.C. 1974. Marine zoogeography. McGraw-Hill, N.Y.

Chou, L.M., Paphavasit, N., Kastoro, W.W., Narcorda, H.M.E., Othman, B.H.R., Loo, M.G.K. & Soedibjo, B.S. 1994. Soft-bottom macrobenthic communities of the ASEAN region and the influence of associated marine ecosystems. *In:* Wilkinson, C.R., Sudara, S. & Chou, L.M. (Eds.), Proceedings, Third ASEAN-Australia Symposium on Living Coastal Resources, 16-20 May 1994, Bangkok. Australian Institute of Marine Science, Townsville. Pp. 325-331.

Erdmann, M.V. & Moosa, M.K. 1999. A new discovered home for "old fourlegs": the discovery of an Indonesian living coelacanth. Pesisir dan Lautan, 2(1): 31-35.

Fortes, M.D. 1995. Seagrasses of East Asia: environmental and management perspectives. RCU/EAS Technical Resports Series. No. 6. United Nations Environment Programme, Bangkok. 81 p.

IUCN/UNEP 1985. Management and conservation of renewable marine resources in the East Asian Seas region. UNEP Regional Seas Reports and Studies No. 65. United Nations Environment Programme. 86 p.

Japar, S.B. 1994. Mangrove plant resources in the ASEAN region. *In:* Wilkinson, C.R., Sudara, S. & Chou, L.M. (Eds.), Proceedings, Third ASEAN-Australia Symposium on Living Coastal Resources, 16-20 May, 1994, Bangkok. Australian Institute of Marine Science, Townsville. Pp. 123-138.

Kelleher, G., Bleakley, C. & Wells, S. (Eds.). 1995. A global representative system of marine protected areas. Vol. 3, Central Indian Ocean, Arabian Seas, East Africa and East Asian Seas. The World Bank, Washington, D.C. 147p.

Kiswara, W. 1994. A review: seagrass ecosystem studies in Indonesian waters. *In:* Wilkinson, C.R., Sudara, S. & Chou, L.M. (Eds.), Proceedings, Third ASEAN-Australia Symposium on Living Coastal Resources, 16-20 May 1994, Bangkok. Australian Institute of Marine Science, Townsville. Pp. 259-281.

Low, J.K.Y., Arshad, A. & Lim, K.H. 1994. Mangroves as a habitat for endangered species and biodiversity conservation. *In:* Wilkinson, C.R., Sudara, S. & Chou, L.M. (Eds.), Proceedings, Third ASEAN-Australia Symposium on Living Coastal Resources, 16-20 May 1994, Bangkok. Australian Institute of Marine Science, Townsville. Pp. 157-169.

McManus, J.W. 1992. The Spratley Islands: a marine park alternative. NAGA, The ICLARM Quarterly (July): 4-8.

Myers, R.F. 1991. Micronesian reef fishes: a practical guide to the identification of the inshore marine fishes of the tropical central and western Pacific. Second edition. Coral Graphics, Guam. 301p.

Pet, J.S. & Yeager, C. (Editors). 25 Year Master Plan for Management, 2000-2025, Komodo National Park. Books 1-3. Komodo National Park's Authority, Indonesia.

Rosewater, J.1972. The family Littorinidae in the Indo-Pacific. Part ll. The subfamilies Tectariinae and Echininae. Indo-Pacific Mollusca, 2(12): 507-534.

Singh, H.R., Chong, V.C., Sasekumar, A. & Lim, K.H. 1994. Value of mangroves as nursery and feeding grounds. *In:* Wilkinson, C.R., Sudara, S. & Chou, L.M. (Eds.), Proceedings, Third ASEAN-Australia Symposium on Living Coastal Resources, 16-20 May 1994, Bangkok. Australian Institute of Marine Science, Townsville. Pp. 105-116.

Sudara, S., Nateekarnjanalarp, S., Thanrongnawasawat, S, Satumanaptan, S. & Chindonnirat, W. 1991. Survey of fauna associated with the seagrass community on Aow Khung Krabane, Chantaburi, Thailand. *In:* Alcala, A.C. (Ed.), Proceedings of the Regional Symposium on Living Resources in Coastal Areas, Manila. University of the Philippines, Manila. Pp. 347-362.

UNEP. 1996. Report of the workshop on the biology and conservation of small cetaceans and dugongs of Southeast Asia. UNEP(W)/EAS WG. 1/2. United Nations Environment Programme, Bangkok. 101p.

Veron, J.E.N. 1995. Corals in space and time: biogeography and evolution of the Scleractinia. UNSW Press, Sydney. 321p.

Voris, H.K. 1972. The role of sea snakes (Hydrophiidae) in the trophic structure of coastal ocean communities. Journal of the Marine Biological Association of India,14(2): 429-442.

Wallace, C.C. 1994. New species and a new species-group of the coral Genus *Acropora* (Scleractinia: Astrocoeniina: Acroporidae) from Indo-Pacific locations. Invertebrate Taxonomy, 8: 961-988.